Field Programmable Gate Arrays for IoT

Joseph Tobon
Dept. of Informatics
New Jersey Institute of Technology
jet33@njit.edu

Juan Contreras and Stephen Williams
Dept. of Electrical and Computer Engineering
University of Central Florida
{johne1312, Stephen.Williams}@knights.ucf.edu

Dr. Mingjie Lin
Dept. of Electrical and Computer Engineering
University of Central Florida
mingjie@eecs.ucf.edu

Abstract

This poster will provide an in depth description for project 4. Project 4 is a part of an NSF funded REU program focusing on IoT (Internet of Things) and is being conducted at the University of Central Florida. Project 4 focuses on assessing and implementing energy efficient computing devices for IoT. More specifically, this project focuses on the implementation and use of FPGAs (Field Programmable Gate Arrays). FPGAs can be an instrumental and an invaluable element of the Internet of Things paradigm. This project will further discuss the specifics and goals of this project, specifics on FPGAs, the impact of FPGAs in IoT, and the projects that have been completed.

Goals

The main goals of this project, provided by the faculty mentor, are as follows:

- Learn Verilog
- Learn Vivado
- Learn the Basys 3 FPGA
- Use this knowledge gathered from research to carry out interesting projects involving these three elements.

Verilog and Vivado

- Verilog is an HDL (Hardware Description Language).
- HDLs are used to program and specify the structure and behaviors of hardware, such as FPGAs.
- Verilog combines elements of the programming language C and other popular HDLs.
- Vivado is an IDE (Integrated Development Environment), created by Xilinx
- Vivado is used to synthesize hardware through the use of an HDL.
- Vivado is the main tool used to program the Basys 3 FPGA used in this research project.

Completed Projects

A concise list of projects completed, in order to meet the goals set out by faculty mentor, are as follows:

- LED light switch with blinking light
- Bit addition utilizing 7-segment display
- Stopwatch utilizing 7-segment display

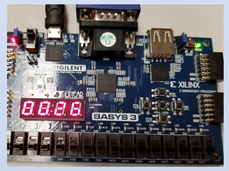
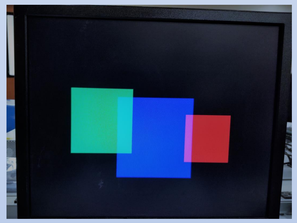


Figure 1: Stopwatch Project

- Animated squares utilizing VGA (Video Graphics Array) output

Figure 2: Animated VGA Project



- Pong

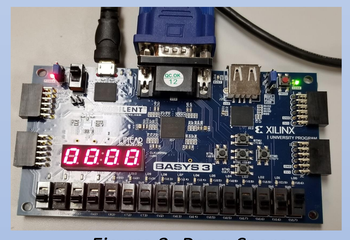


Figure 3: Pong Score

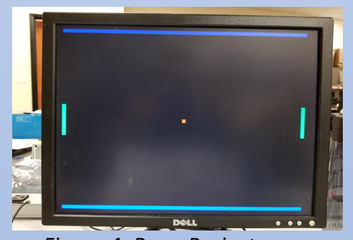


Figure 4: Pong Project

- Rhythm Game

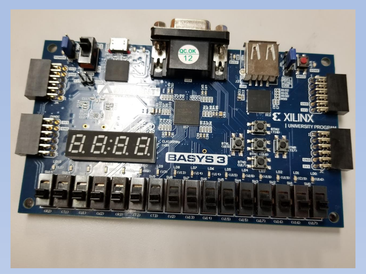


Figure 5: Basys 3 FPGA

FPGAs in IoT

- FPGA stands for Field Programmable Gate Array.
- Their main function, as the name describes, are to be highly reprogrammable silicon chips.
- These boards are entirely reconfigurable and doing so does not take a significant amount of time
- They run multiple processes in parallel, or at the same time.
- The challenges, that can be helped by FPGAs in IoT include power efficiency, incompatible interfaces, and processor migrations.
- Big companies, like Microsoft, are utilizing FPGAs to change the way that key IoT components of their company operate.

References

[1] Introduction to fpga technology: Top 5 benefits. http://www.ni.com/whitepaper/6984/en/toc1. Accessed: 2018-06-13.

[2] H. Demel and L. S. Corporation. Fpgas solve challenges at the core of iot implementation. https://www.edn.com/electronics-blogs/eye-on-iot/4442318/FPGAs-solve-challenges-at-the-core-of-IoT-implementation. Accessed: 2018-06-14.

[3] D. Tala. History of verilog. http://www.asic-world.com/verilog/history.html. Accessed: 2018-06-14.

Acknowledgements

The support for this work was provided by the National Science Foundation REU program under Award No. 1560302. Any opinions, findings, and conclusions and recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.